Paper No. 30

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte
TURGUT SAHIN,
YAXIN WANG,
and MING XI

Appeal No. 2001-2182
Application No. 08/948,895

ON BRIEF

Before WALTZ, LIEBERMAN and DELMENDO, Administrative Patent Judges.

LIEBERMAN, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134 from the decision of the examiner refusing to allow claims 1 through 3, 6, 7, and 9 through 20 which are all the claims

pending in this application. Claims 6, 7, 9 through 14 and 16 through 20 were amended subsequent to the final rejection.

THE INVENTION

The invention is directed to a method of improving adhesion of a fluorine containing dielectric material to a substrate surface wherein an adhesion layer is deposited on a metal substrate and a fluorine containing dielectric layer is thereafter deposited on the adhesion layer. The method further requires that either SiN or SiON is deposited on internal surfaces of a deposition chamber. The SiN or SiON blocks gassing of fluorine from internal surfaces of the deposition chamber. In a further embodiment TiN is deposited on the metal substrate and acts as an adhesion layer. The TiN is thereafter exposed to nitrogen plasma. Additional limitations are described in the following illustrative claims.

THE CLAIMS

Claims 1, 6 and 16 are illustrative of appellants' invention and are reproduced below.

1. A method of improving adhesion of a fluorine containing dielectric material to a substrate surface, comprising:

depositing silicon nitride or silicon oxynitride on internal surfaces of a deposition

chamber in an amount sufficient to block out gassing of fluorine from the internal surfaces;

positioning a substrate comprising metal surfaces in the deposition chamber;

depositing at least one adhesion layer on the substrate; and

depositing a fluorine containing dielectric material on the adhesion layer.

6. A method of improving adhesion of a fluorine containing dielectric material to a substrate surface, comprising:

depositing silicon nitride or silicon oxynitride on internal surfaces of a deposition chamber in an amount sufficient to block out gassing of fluorine from the internal surfaces;

positioning a substrate comprising metal surfaces in the deposition chamber;

depositing a TiN layer on the substrate;

exposing the TiN layer to a nitrogen plasma; and then

depositing a fluorine containing dielectric material on the TiN layer.

16. The method of claim 6, wherein depositing the fluorine containing dielectric material comprises:

introducing a carbon source gas and a fluorine source gas into the deposition chamber, wherein the ratio of carbon gas source and fluorine gas source is selected to maintain an atomic ratio of fluorine to carbon (F:C) less than about 2:1;

delivering a source power to the chamber sufficient to strike a plasma in the chamber; and

applying a bias to a substrate support member in an amount above about 300W.

THE REFERENCES OF RECORD

As evidence of obviousness, the examiner relies upon the following references:

Shankar et al. (Shankar)	4,782,380	Nov. 01, 1988

Sandhu et al. (Sandhu)	5,284,365	Oct. 20, 1998 (Filed Jun. 24, 1996)
Tsukune et al. (EP'656) (Published European Patent Application)	387,656	Sep. 19, 1990
Kim et al. (GB'345) (Published UK Patent Application)	2,299,345	Oct. 02, 1996
Endo et al. (EP'283) (Published European Patent Application)	701,283	Mar. 13, 1996

Endo, K et al. (Endo), "Preparation and Properties of Fluorinated Amorphous Carbon Thin Films by Plasma Enhanced Chemical Vapor Deposition", Materials Research Society Symposium Proceedings, Vol. 381, pp. 249- 254 (1995).

THE REJECTIONS

Claims 1 through 3 stand rejected under 35 U.S.C. §103(a) as being unpatentable over EP'283 in view of EP'656 and Shankar.

Claim 15 stands rejected under 35 U.S.C. §103(a) as being unpatentable over EP'283 in view of EP'656 and Shankar and further in view of Endo.

Claims 6, 7 and 9 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Shankar in view of EP'656, GB'345 and EP'283.

Claims 10 through 14 and 16 through 20 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Shankar in view of EP'656, GB'345 and EP'283, and further in view of Endo.

Claims 1 through 3 stand rejected under 35 U.S.C. §103(a) as being unpatentable over EP'283 in view of Sandhu and Shankar.

Claim 15 stands rejected under 35 U.S.C. §103(a) as being unpatentable over

EP'283 in view of Sandhu and Shankar and further in view of Endo.

Claims 6, 7 and 9 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Shankar in view of Sandhu, GB'345 and EP'283.

Claims 10 through 14 and 16 through 20 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Shankar in view of Sandhu, GB'345 and EP'283, and further in view of Endo.

OPINION

We have carefully considered all of the arguments advanced by the appellants and the examiner and agree with the appellants that the rejections of the claims under §103(a) are not well founded. Accordingly, we reverse each of these rejections.

"[T]he examiner bears the initial burden, on review of the prior art or on any other ground, of presenting a *prima facie* case of unpatentability." See In re Oetiker, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992). The examiner relies upon a combination of from three to five references to reject the claimed subject matter and establish a prima facie case of obviousness.

The combination of references before us discloses each of the elements required by the claimed subject matter. With respect to claim 1,EP'283 relied upon as the primary reference in each of the rejection of claim 1, is directed to a semiconductor device including an insulative interlayer, i.e., an intermediate layer, composed of amorphous

carbon film which may include fluorine therein. See page 3, lines 1-22 and Figure 3. In Figure 3, a transistor was fabricated on a silicon substrate **31**. See page 8, line 22. Silicon dioxide films **32** were thereafter deposited on selected portions of the silicon substrate **31**. See page 8, lines 31-32. A first aluminum layer, **33**, was thereafter deposited on portions of layers **31** and **32**. See Figure 3. Thereafter, an amorphous carbon film or a fluorinated amorphous carbon film **34** is deposited on the aluminum layer followed by a second aluminum layer **35**. See Figure 3 and page 8, lines 27 -37. Absent from the disclosure of EP'283 is a discussion of an adhesion layer, and the deposition of SiN or SiON, (silicon nitride or silicon oxynitride) on internal walls of a deposition chamber.

Thereafter a series of secondary references is relied upon to disclose each of the other elements of the claimed subject matter. EP'656 is relied upon by the examiner for its disclosure of, "making a plasma self cleaning within a chamber using a gas which includes fluorine, coating an inside of the chamber by a first layer of a material which includes silicon and nitrogen." See column 2, lines 1-7. The layer which coats the inside of the chamber includes SiN and SiON as required by the claimed subject matter. See column 5, lines 8-10. Accordingly, EP'656 discloses the element of "depositing silicon nitride or silicon oxynitride on internal surfaces of a deposition chamber."

In an alternative rejection, in place of EP'656, the examiner relies upon Sandhu who discloses a method of inhibiting the deposition of material on the walls of a chemical vapor deposition reactor. See column 1, lines 6-7 and column 3, lines 21-25. The

material layer may be most preferably silicon nitride. See column 3, lines 36-38. Accordingly, in the alternative rejection, Sandhu discloses the claimed element of "depositing silicon nitride or silicon oxynitride on internal surfaces of a deposition chamber."

Thereafter Shankar is relied upon for the disclosure of a barrier layer which includes TiN. See column 3, lines 47-49. A lower barrier layer of TiN is formed over an oxide layer. See column 3, lines 38-39. See Figure 1. The multilayer formation includes lower barrier layer **40**, aluminum base metal **50** and upper barrier layer **60**. See column 6, lines 1-2. The upper barrier layer may be formed from the same material as the lower barrier layer, i.e., TiN. See column 5, lines 29-32. Moreover, a Ti/TiN barrier layer is disclosed as being preferred because, "the titanium metal layer below the titanium compound or alloy will adhere well to both the exposed silicon where the electrical contact is to be made as well as to the adjacent oxide layer." See column 4, lines 7-16.

The examiner admits that EP'283, "does not disclose depositing an adhesive layer such as TiN layer on the substrate prior to depositing the fluorinated amorphous carbon." See Answer, pages 5 and 9. In view of the teachings of Shankar however, the examiner concludes that, "it would have been obvious to have deposited lower and upper TiN barrier layers around the aluminum lines of EP 701283 because doing so would have been expected to have prevented diffusion of aluminum into the silicon substrate and improved the electromigration resistance of the wiring line." See Answer, pages 5, 9 and 10.

With respect to the rejection of claim 6 there are two rejections before us. The examiner relies upon the same references albeit in a different order, i.e., Shankar in view of EP'656, EP'283 and GB'345 or Shankar in view of Sandhu, EP'283 and GB'345. Each of the references is relied upon for the same teaching of the individual elements required by the claimed subject matter as previously discussed.

In each of the rejections before us, the motivation for combining EP'283 with Shankar relied upon by the examiner is that, "because EP 701283 discloses that fluorocarbon layers are better IMD materials than silicon oxide (pages 2-3), it would have been obvious to have deposited an amorphous fluorocarbon layer on the nitrided TiN layer of Shankar et al. rather than the oxide layer because the amorphous fluorinated carbon would have been expected to be a better IMD material than silicon oxide."[1] See Answer, pages 7 and 12.

In the rejection of both independent claims 1 and 6, the examiner combines EP'283 with Shankar by adding a dielectric layer disclosed by EP'283 to a barrier layer disclosed by Shankar. The motivational statement however does not address the issue why one of ordinary skill in the art would have combined the two layers or where such combination is suggested or taught by the prior art. It has not been explained why a barrier layer should be inserted prior to the addition of an amorphous fluorinated carbon layer. Stated otherwise, it is not explained why a barrier layer should be followed by an

[1]IMD is an intermetal dielectric layer.

amorphous fluorinated carbon dielectric layer. Furthermore, it has not been shown that the two layers would adhere to each other or be compatible with each other.

Finally, we conclude that the present combination of three to five references each of which discloses either a single element or at most two elements of the claimed subject matter constitutes a hindsight reconstruction of the claimed invention, particularly in view of the multi-substitutions required to obtain the claimed subject matter. See In re Dembiczak, 175 F.3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999) ("[T]he best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references.").

For the foregoing reasons, the rejection of claims 1 and 6 is not sustained. Furthermore, in light of our reversal of claims 1 and 6, the sole independent claims before us, we need not discuss the balance of the rejections of record. A discussion of GB'345 and Endo is not needed in reaching our decision as each of the references are directed exclusively to features which appear only in dependent claims and in any event do not remedy the deficiency of the other references.

DECISION

The rejection of claims 1 through 3 under 35 U.S.C. §103(a) as being unpatentable over EP'283 in view of EP'656 and Shankar is reversed.

The rejection of claim 15 under 35 U.S.C. §103(a) as being unpatentable over EP'283 in view of EP'656 and Shankar and further in view of Endo is reversed.

The rejection of claims 6, 7 and 9 under 35 U.S.C. §103(a) as being unpatentable over Shankar in view of EP'656, GB'345 and EP'283 is reversed.

The rejection of claims 10 through 14 and 16 through 20 under 35 U.S.C. §103(a) as being unpatentable over Shankar in view of EP'656, GB'345 and EP'283, and further in view of Endo is reversed.

The rejection of claims 1 through 3 under 35 U.S.C. §103(a) as being unpatentable over EP'283 in view of Sandhu and Shankar is reversed.

The rejection of claim 15 stands rejected under 35 U.S.C. §103(a) as being unpatentable over EP'283 in view of Sandhu and Shankar ands further in view of Endo is reversed.

The rejection of claims 6, 7 and 9 under 35 U.S.C. §103(a) as being unpatentable over Shankar in view of Sandhu, GB'345 and EP'283 is reversed.

The rejection of claims 10 through 14 and 16 through 20 under 35 U.S.C. §103(a) as being unpatentable over Shankar in view of Sandhu, GB'345 and EP'283, and further in view of Endo is reversed.

The decision of the examiner is reversed.

REVERSED

THOMAS A. WALTZ Administrative Patent Judge	)
PAUL LIEBERMAN Administrative Patent Judge	) BOARD OF PATENT) APPEALS) AND) INTERFERENCES
ROMULO H. DELMENDO Administrative Patent Judge	)

PL/lp

APPLIED MATERIALS, INC.
2881 SCOTT BLVD. M/S 2061
SANTA CLARA, CA 95050